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1870

MINERAL WEALTH OF MISSOURI.

TWO LECTURES

DELIVERED IN THE HALL OF REPRESENTATIVES,

AT

JEFFERSON CITY, MO.,

FEBRUARY 17TH AND 18TH, 1870,

IN ACCORDANCE WITH HOUSE RESOLUTIONS.

I. MINES AND MINING EDUCATION.

II. COAL AND IRON.

BY PROF. C. D. WILBER, INSPECTOR OF MINING LANDS.

WITH AN APPENDIX.



FIFTH THOUSAND.

ST. LOUIS: E. J. CRANDALL, 311 PINE STREET.

HANNIBAL: C. O. GODFREY, CRUIKSHANK'S BUILDING.

CHICAGO: ADAMS, BLACKMER & LYON, 155 RANDOLPH ST.

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MINES AND MINING EDUCATION.

The interest with which minerals and mineral wealth are regarded is universal. A man is only a walking cabinet of minerals—a microcosm of metalloids. Besides definite proportions of phosphates, carbonates, nitrates, hydrates, and oxides, what is he? Chemically considered, Adam was 35 pounds of phosphate of lime, distributed through 5 pails of water; while Eve required for her corporeal existence only 25 pounds, with 4 pails of water.

“Dust thou art, and unto dust shalt thou return.” This law distributes him to the sources whence he came, gathers up and restores the fragments or atoms, so that nothing is lost. The earth is our mother, and the eagerness with which we listen to her revelations, is it not inborn?

We will further say that in proportion as we recede from barbarism and advance towards civilization, our progress is marked by the discovery of minerals, the increased production of mines, and by frequent discovery of new uses of metals. Gold, Silver, Copper, Lead, Tin, and Iron—these are the pavements on which humanity marches onward—and the golden streets of the New Jerusalem are only the earnest of industrial progress continued and enjoyed forever!

With this acknowledged connection between men and minerals, let us trace some of the metallic veins up through human history, and we shall see that our zeal for metals—whether coarse or precious, most civilized, as we claim to be—is far greater than the ancients ever possessed.

While they worship metallic images we worship the precious metal itself, not atheistic nor idolatrous, but as unqualified trinitarians—devotees, acceptable and orthodox, of the American trinity,—the golden eagle, the silver dollar, and the copper cent. And

it is the force of this religion in us that will draw us back to a specie basis in spite of all the recommendations of the Forty-first Congress.

The rudest tribes of mankind have neither ideas nor uses of metals. The Boshman, Caffre, or Hottentot, appreciates a cowry above a piece of silver or gold. A Cheyenne or Apache Indian prefers a flint to a ruby, and swine prefer artichokes to pearls.

In earlier times we find the use of silver most prevalent. It was currency, or money. For the purchase of Hebron, Abraham weighed the price in silver, "current money with the merchants." Of gold and silver large quantities were used for ornaments of the person, and the adornment of temples; also for ransoms, tributes, and taxes. Sums or weights of silver and gold are noted which indicate that the mining industry of the Egyptian, Assyrian, Persian, Jewish, Grecian, and Roman empires was co-extensive with their greatness. The city of Damascus paid a tribute of 2,300 talents of silver to Babylon (a talent is \$2,000 nearly), and according to Pliny, Cyrus obtained £7,720,000,000 from the conquest of Asia. From Herodotus we learn that the yearly tribute paid to the Persians was 3,000,000 lbs in silver. During 50 years Carthage paid as tribute to Rome 9,000 lbs, Troy, of silver. Caligula ornamented the armor and weapons for his grand circus or coliseum with 124,000 lbs of silver.

The ancients obtained metals from many localities. Eschylus describes the mines of Larium as "the fountains of the silver treasure of the earth." The modes of obtaining ores, or mining and the methods of reducing them, were of the rudest sort. They were simple, involving little or no cost, and calculated to waste more than they saved.

Diodorus says that the shepherds on the Pyrenees mountains set fire to the forests, causing the silver in the rocks to melt and run down in numerous streams.

The Carthagenians employed 40,000 men to work the Spanish mines, and the Moors, their successors, continued the work; but so wastefully was it performed, that a German colony of miners, in 1571, took out \$20,000,000 of silver from the refuse of former workings.

German mining began as early as the seventh century. The Bohemian silver mines were opened in the tenth century, and the Tyrolese mines in the twelfth century. Bohemia gave laws and methods of mining, and developed a spirit of enterprise spreading north and west throughout Europe. As a consequence, the mines of England, France, Hungary and Norway were opened.

The discovery of America was a new era in the history of mining, particularly on account of the vast wealth which poured into Europe from South America and Mexico.

The Peruvians had no fixtures or machines, or knowledge of mining. They smelted surface ores and such as could be found above water. Their furnaces were scooped out of hill or mountain side, and the smelting flames were dependent upon the winds.

We cannot estimate the amount of silver thus obtained. The soldiers of Pizarro found, not far from Cuzco, three beams of silver, each twenty feet long, one foot in width, and three inches thick; probably bench planks for the portico of a nobleman's residence. Atahualpa's ransom, in gold and silver ornaments, contributed by his loving subjects, was valued at £3,500,000 of gold, and 25,805 lbs. Troy of silver.

The Pasco mines were discovered in 1680, and were worked without any order or system, except systematized cruelty. One day a portion of the mine caved in, and killed three hundred miners. The mine was named "Kill People," or Matagenti, afterwards. The amount of silver smelted at these works, from 1784 to 1827, was 4,967,710 pounds Troy.

Bolivia contains mines still richer than those of Peru. "Potosi," or Silver Mountain, discovered in 1545, has yielded £240,000,000 worth of silver, or \$1,200,000,000.

The mines of Peru and Bolivia, under circumstances most discouraging, "of wars and rumors of wars," have yielded 155,839,180 pounds Troy of silver.

Humboldt estimates the annual yield of the mines of Mexico, during their early period, at \$2,000,000 to \$3,000,000. In the eighteenth century the production was increased to \$23,000,000 per annum.

The gold and silver crop of California, since 1846, exceeds one thousand millions of dollars ! and this we may consider as the mere *out-crop*.

The obstacles which everywhere opposed mining—shafting, drifting, gangue-cutting, flooding, &c., &c., led to the invention of machinery, based upon the study of mechanics and hydraulics. As necessity is the mother of invention, so mining industry has given us the engines that now perform nine-tenths of all labor. The steam engine was called into existence by the irrepressible will of miners, to force water out of the Cornish mines.

It was indeed a great triumph for a Watt engine to lift 5,590,000 pounds of water one foot, by using one bushel of coal.

Smeaton increased the duty of an engine to 9,459,000 pounds. In 1776, engines could raise 19,000,000 pounds one foot, with one bushel of coal.

In 1823 an engine raised 28,000,000 pounds. In 1843, 60,000,000 pounds. Austen's engine, eighty-inch cylinder, raised 96,000,000 pounds. So perfect and powerful are these engines now, that a farthing worth of coal will raise $2\frac{1}{4}$ tons of water 600 feet.

The mining districts of England alone, produced this grand result, and contributed the steam engine to the world's industry.

The locomotive—so deservedly popular in this country—was an after-thought, and at first only an automaton truck-wagon to move the increased products of mines worked by engines. But so numerous has this new born race of coal consumers become, that we are now obliged to seek and work coal in every land in order to procure fuel or food to maintain them.

Two thousand locomotives going to and fro, night and day, in the Mississippi Valley—consuming one ton of coal for every forty miles of transit, added to these three times the number of stationary engines, equally voracious—this *fact* bears strongly upon the importance of coal mining in our country. So great is the annual consumption of coal that we are already estimating the amount we have on hand, or rather in *bank* to meet both present and future demands. Already are we seeking to know *how* and *where* it is distributed and *how long* it will last.

The answer is quite encouraging. From the Alleghenies, Pennsylvania, Ohio, and Virginia; from Illinois, Iowa, Indiana, Kentucky, and Missouri, comes the assurance, not with figures of rhetoric, but of arithmetic, that we have for all these purposes enough to last 700,000 years!—beyond which limit we have no anxious care!

In the States and Territories west of the Mississippi River there is still a deep concern upon the question of fuel. It is not yet settled as regards the plains of Kansas, Nebraska, Colorado and the Indian Territory.

The headlights of another thousand locomotives will soon illumine those plains, long ago dedicated to desolation, and named by our fathers, the Great American Desert.

To welcome these missionaries of peace and prosperity, and lying in the way of every railroad to the Pacific, is the great Colorado coal-field.

It reaches from the British possessions into Mexico, 1,200 miles; and is in many places 120 miles in width, and contains five workable beds of coal from five to twenty feet thick. It is the largest and most valuable deposit of coal in the world.

It will supply for ages all the homes of herdsmen upon the plains who will utilize or occupy every acre of that tenantless domain—[a better land to-day than the country of Abraham, Isaac, and Jacob—and far better than John Chinaman ever knew.]

It will form and fashion, spin and weave, utensils and fabrics for the coming millions that will there seek and find prosperous homes.

Based upon mining industry, the country west of the Mississippi—the Western States—will, in less than half a century, exhibit a reign of prosperity unequalled in the history of the race.

“ Westward the star of empire takes its way.
The first four acts, already past,
The fifth shall usher in the glorious day :
Time’s noblest empire is the last.”

But let us look within the borders of Missouri—a State so attractive to capital that the national Capitol has begun to march hither; and be assured that it will arrive on time! No State has been so highly favored with mineral wealth. Although little ex-

plored, comparatively, yet it has attained and will maintain the *first* place as the source of minerals and metallic ores, and the day is not far off when the manufactured products of her mining industry will give her a like position. With her own hands she shall obtain riches more valuable than her inheritance.

It is, *par excellence*, "the *Iron State*." Pilot Knob is only a symbol, and is rising higher and higher in the world's estimation.

We extract from Dr. Litton's description :

"The quantity of pure iron ore at the Pilot Knob is not, probably, less than all that portion of the mountain above the elevation of 440 feet above its base ; for, beneath this point, there are large masses above the base of the hill. A section of the Pilot Knob, 440 feet above, and parallel with its base, would cover an area of not less than fifty-three acres. Considering the upper 141 feet as composed entirely of iron ore, and as a cone, with a base of fifty-three acres, it would make 108,507,960 cubic feet of iron ore ; which volume, if water, would weigh 6,760,045,900 pounds. The specific gravity of three different specimens of the Pilot Knob ore was found to be 4.75, 4.49, and 4.66, the mean of which is 4.63 ; and taking the last as the average specific weight of the ore, it would give, for the total weight of the ore, upon the above supposition, in the upper 141 feet of the Pilot Knob, 31,299,012,554 pounds, or 13,972,773 tons."

It is probably the head of the king bolt, binding the two hemispheres together !

"From surface indications, and from all explorations made, the whole Iron Mountain seems to be a mass of iron ore. The elevation of its summit above the valley varies according to the point at which the measurement is made ; and, from the survey of the rail road, I take for its height, 228 feet ; and at this depth, below its summit, its base cannot cover a smaller area than 500 acres. Considered as a cone, with a base of 500 acres, and a height of 228 feet, the solid contents of that portion *above the surface* is 1,655,280,000 cubic feet. One cubic foot of water weighs 16.3 pounds, avoirdupois ; and were this mass water, its total weight would be 103,123,944,000 pounds. But the determination of the specific gravity of two specimens of the ore has shown that it is between

5.05 and 5.23 times heavier than water. Considering it, however, as only five times heavier, it would give for the total weight of the iron ore, above the surface, 1,515,619,720,000 pounds, or 230,187,375 tons."

In the vicinity there are other mountains, mounds, hills and dykes of iron. In fifteen counties of south-eastern Missouri are dykes and knobs of the purest specular and hermatite ores, and in quantities which defy exhaustion.

Take a few analyses :

1st. From an iron mountain in Dent county, a few miles from the Southwestern Pacific Railroad, and 120 miles from St. Louis, belonging to Judge Simmons :

Metallic iron.....	68.87, Weiss.
" "	69.81, Beauregard.
Mass.....	98.23, Weiss.
"	97.00, Beauregard.

Two specimens from near Rolla, Phelps Co., Missouri, contains as follows :

No. 1 :

Hematite ore.....	64 00 metallic iron.
.....	27.43 oxygen.
.....	.64 water.
.....	6 20 insoluble silica.
.....	.02 phosphorous.
	98.29

No. 2 :

.....	63.72 metallic iron.
.....	27.31 oxygen.
.....	5.80 insoluble silica.
.....	1.69 water.
.....	.03 phosphorus.
	98.55 Brock, Philada.

The ores of England, Wales and Scotland are, as a class, far inferior to these, yielding from 28 to 46 per cent. metallic ore.

Across the Mississippi river—the city of St. Louis between—are

strata of coal of corresponding magnitude. Within fifty miles of St. Louis there is coal sufficient in quantity, and well adapted as to quality, to smelt every ton of iron above described.

The bans of matrimony between these two loving subjects—Coal and Iron—have been declared, and St. Louis—the home of the bride—is their chosen residence. The bridegroom is black, but comely, and I move that the privilege of the Fifteenth Amendment be extended to them.

Iron is the most valuable of the metals, because it is the most useful. It is also the most widely distributed, no part of the earth being without it. In the mechanic arts it is the right hand, and, indeed, has furnished to every man a hundred hands, so that in modern days a person can be Vulcan and Briareus at the same time. It combines a thousand uses, and has a vast residue latent, which will be easily evoked by the dextrous cunning of men. It does anything, everything! It serves anywhere, everywhere! Let a person name, if he can, any implement, or article of food or clothing, that has not been fashioned with iron fingers.

We walk upon iron pavements, and sit upon iron chairs; we live in iron houses, and sleep upon iron beds, made soft with springs of steel; we attend an iron church and occupy iron pews, listen to a sermon written upon iron paper with a pen of iron, and return to our own hearths and firesides: we travel on iron roads, in cars made of iron, drawn by iron steeds.

On the trackless ocean an iron needle points out the way, like an unerring finger. With iron wands, weird and wired, we have annihilated Time and Space, and made of all nations one neighborhood. And lastly, with iron ships, we have revolutionized the whole art of modern warfare, and fought and won the greatest battles of history!

Lead, Zinc, Tin, Copper, and many minerals useful in every day life are here in force, but we can describe them neither fairly nor fully, on account of the incompleteness of reports. The State has done nothing to ascertain of what account or extent they are, during the past ten years. These examinations have been left to capitalists and adventurers, who are continually being enriched, and are indifferent in regard to making reports. Lead is being mined

in the southwestern and middle counties of Missouri in large quantities, and proves to be the best article in the market, and commanding $\frac{1}{2}$ to $\frac{1}{4}$ cent per pound advance.

At one establishment in Jasper County 33,000 pounds of mineral are smelted daily, yielding 22,000 pounds pure lead. The per cent. of lead is 71 to 75.

It has been found in twenty counties of southwestern Missouri, and in more than five hundred localities, in an area of 6,000 square miles.

At Granby, in Newton County, the lead comes to the very surface of the ground, and mining at this point has been successful beyond precedent. The lead is found in somewhat regular leads, or pockets, or disseminated through the bed of chert, clay, sand, and limestone, partially cemented, which overlies the Mountain limestone. The sulphuret of lead, or galena, is the most abundant ore. Pure galena contains 13.34 per cent of sulphur and 86.66 per cent. of lead. The Center Creek and Turkey Creek mines in Jasper County, and also the mines at Newtonia, Newton County, are being worked successfully. The statistics of one shaft will give an idea of the quantity of ore raised and the profits of mining in this county, being 100,000 pounds of galena per month. In one week alone it yielded 50,000 pounds, which, at \$20 per thousand, would amount to \$1,000; deduct \$150 for expenses, and the profits alone were \$850 for the week; they will average \$1,500 per month. Hundreds of shafts have been sunk and are yielding similar profits. The amount of mineral smelted in this county last year was 10,000,000 pounds.

The coal fields of Missouri—though not yet determined—are ample, and for the most part of excellent quality. The largest of them is the Chariton coal field, extending north and south 150 miles on both sides of the Chariton river, from Iowa to the Missouri river. It has an average width of 30 miles. It contains four beds of coal, all within 150 feet of the surface, the lower vein bearing $4\frac{1}{2}$ feet thickness.

There is also a considerable distribution of coals in southwestern Missouri, especially in that portion known as the prairie counties. These coals are uniformly good, but are not persistent either as to

thickness or direction. The railroads now in construction extend across the coal as well as lead districts.

Will our coals work our ores ; especially iron ores ? We answer yes. They were put here for that purpose, and we may suspect our ignorance rather than question the arrangements of the Creator. The Germans make iron and steel by the use of coke, made from poorer coals than can be found in Missouri. The great beds of cannel coal, found in Callaway, Howard, and Boone counties, are from 10 to 40 feet in thickness, and have an area of 1,500 square miles. They are so rich in oil that every ton will yield 80 gallons of crude oil, at a cost not exceeding 10 cents per gallon. The iron retort, and a carboy of sulphuric acid constitute the necessary apparatus for producing refined oil. These coals will be distilled for this purpose at no distant date.

The flowing wells of Pennsylvania—those impertinent spouts—are the principal hindrance at present ; but they are short lived : have patience.

On the rim of an argent shield, the coat of one of the States, is this motto : “*Si queris amœnam peninsulam, circumspecte.*” Let us translate it thus : If you are seeking a wonderful land, look around you. Like Canaan beyond Jordan, it is indeed a goodly land. “A land of brooks of water, of fountains, and depths that spring out of valleys and hills. A land of wheat and barley, and vines and fig trees, and pomegranates. A land of oil, olive, and honey. A land wherein thou shalt eat bread without scarceness ; thou shalt not lack anything in it. A land whose stones are iron, and out of whose hills thou mayest dig brass.”

In the light of these facts or first lessons, the duty, or rather the privilege of the commonwealth of Missouri, is unmistakable. If you would invite the Capital and Labor of both hemispheres, send to them a correct inventory of your goods : send them at least a well printed bill of fare, that they may know somewhat of the feast you have ready.

In short, have your State thoroughly and systematically explored by competent men—men of practical as well as scientific ability—and whose record of discovery, description, and analysis are vouchers for their capacity. There are men living in Missouri who can

do this work. A State that claims such men as Litton, Engleman, Shepard, and Shumard, need not look abroad. If others were needed, the labors of such men as Meek, Newbury, Lesquereux and Whittlesey can be commanded.

The best endeavor of the people should be directed to have and maintain a survey of the entire State, conducted with special reference to the development of its staple mineral values ; describing not only the topography and drainage, and giving the areas of arable land in each county, with analysis of soils, but also the extent and direction of each rock formation, with an inventory of its particular values, whether of metals and mineral ores, or coals, clays, cement, building stone, marble, mineral paints ; but including also a descriptive catalogue of fossils—those types of life, or rather illumined letters in the history of world-building, which enable us to read the well ordered chapters of the Stony Book.

The munificence displayed by Divine Beneficence in this State can be best appreciated by giving according as you have received. Give the information which millions are seeking. Write the thousand facts about these mineral treasures in a book and send it away. It will be more marvellous than the story of Alladin's lamp, more interesting than all the novels of Dickens and Thackeray, and will command the attention of the men that control the world's Commerce and Manufactures. And when the State of Missouri shall number two millions of inhabitants, say ten years hence, and a knowledge of her mineral wealth shall have become familiar to all, what shall hinder thousands of her citizens from choosing some particular branch of mining industry, whose united results will be referred to with just pride by your citizens ? " Where no vision is, the people perish." Let us delve and mine, measure and analyze, and run to and fro in the land, until we have greatly increased this knowledge and made it available for the men of skill and industry who, from all countries, are seeking homes within the borders of Missouri.

These remarks lead us naturally to consider the relations of mining industry to the system of education or Public Instruction.

In Europe these relations are understood. Schools of mining and engineering are provided for by the State, and not only so,

but England, France, and Germany have established Mining Bureaus, which direct all surveys under government supervision—having reference, also to the mining schools.

We have, in the United States, done much towards meeting the real wants of the people in this regard, but much yet remains to be done. We have a National Academy of Science and national surveys of mines and mineral values in the Territories.

Mining schools in this country are for the most part individual enterprises, as in New York, Philadelphia, and are generally adjuncts of mining and assay offices.

On the other hand scientific schools are mere departments of our Colleges and Universities, and in most instances are made secondary and inferior to the classical department. But it may be said, we have only a few scientific men who can give weight and worth to such a school.

Start a first class war, and there is no lack of generals; and bravery—the only thing that cannot be discounted for its abundance—comes forth with every emergency. Provide mining and scientific schools and foster them, and we too will raise up such men as Watt, Stevenson, Trevithick, Huxley, Agassiz, Faraday and Humboldt.

No excuse can be plead in our Collegiate institutions for the neglect with which the physical sciences are treated. We do not complain that preferments and rewards are generally given to excellence in the knowledge of Latin and Greek, for these are only toys to please children with. But we do protest against the blindness which constantly invests the classical student with finer robes, and values his knowledge as belonging to a higher grade—which looks with no little reverence upon a person whose mind is familiar only with the usages of Antiquity, which he has learned by groping with a dim light in the dark chambers of the dead languages.

It will not suffice that he knows all these things—as fact, or a mere matter of record. The translated histories will never do. Rollins, Gibbon, Josephus, and the Scriptures—containing a more truthful panorama of the phenomena of human action—all of this is second class by force of the tyranny which is still vigorous in our Colleges and Universities.

The secret spring of this sentiment, or the basis upon which this aristocracy of learning rests, is unworthy of us, and is an outrage upon the liberties of mankind. When analyzed, it means simply this, that the few who study classics and endure and overcome the difficulties incident to them, shall have extra privileges and be considered of superior rank because of such toil and endurance! It cannot be urged that they know *more*, or have more *thorough* knowledge than those who read the best translations in English, for that is impossible. Shall we crown a youth with "laurel and bay" because he has spent a year in a dark cavern? Because one in ten thousand has interpreted for himself a few of the jargons of Babel and spent a few of his best years in threading the labyrinths of ruins made in the rude ages of human history, is he therefore, "altogether lovely?" Shall we put him upon a white steed and lead him about the streets, proclaiming—"Thus shall it be done unto the man whom the King delighteth to honor?"

But it is and often has been urged that the classics give refinement, culture, and discipline to a degree *beyond all other studies*. We not only doubt this, but know that it is not true, and in the nature of things can NEVER be true.

The literature of the classical course, what is it at best?

It is Mythology, Poetry, and History—in short, descriptions of ancient nationalities, by writers then living. Now, what can be said of all the gods and goddesses of the Pantheon or of Pandemonium, when we know that they never had an existence? Shall we study the myths of Roman and Grecian antiquity, for years, being assured at the same time, that every word of it is false—but that for the sake of discipline and culture we must wade through it?

And not only this, but the story of the gods—their words and deeds—their relations to mankind, and constant interference in human affairs, and shaping of individual and national existence—to say nothing of the vices, big and little, which are attributed to them—with rare exceptions—these, are interesting mainly because they are revolting, and for this reason are more fit for an illustrated page in the "Day's Doings," or the "Police Gazette," than in the curriculum of a college in the year of our Lord 1870.

We have said that there is some consolation in the reflection that these gods are not gods ; that, after patiently plodding through with the classical course, we can with the besom of truth, sweep it out, like cobwebs from an untidy room. There was no *such* Jupiter ; nor any giant like Hercules. Mercury was *not* such a busy-body—everywhere present. Juno and Venus and Dido—why, they were myths ; and the highest success of “Woman’s Rights” will not culminate in such characters, and we need not apologize for them.

“ But he retains in his mind the vigorous discipline of the course.” We doubt it ; he may be sharpened as to those faculties most in use—like the point and side of a plow—but his imagination, the picture gallery of the soul, has been impaired by beholding a panorama of false pictures, of unreal things, and the citadel of the soul—the heart, where all that is royal and noble in man resides—this has not been strengthened, but weakened, by these false and insufficient methods of instruction. We have come to entertain serious doubts concerning the refining process of a classical education.

Will a seven years’ residence on Mount Olympus, or Mount Ida, at Delphos—among the “ Gods of Greece ”—or Rome, or, still farther, with “ Osirus, Orus, Apis, Isis,” give us us this, the most estimable jewel of the crown ?

It requires a year to follow the exploits of Bacchus, in the Odes of Horace. [We use the expurgated or washed editions—a second washing would do no harm.] Virgil and Juno conduct the exercises in Virgil, chiefly. Jupiter, Neptune, Vulcan—the strong gods—are seldom seen in comedy, and retreat after putting in an occasional appearance.

In reading the Metamorphoses of Ovid, hold your book to the leaward, not the windward side. And as for most classic orators—Cicero and Demosthenes—every graduate knows that they are full of oaths ; as downright swearing and profanity as the lips of men can utter. It is true, it is only “ Ma tous Theous ! ” “ by all the gods ! ” “ Mehercle ! ” “ by Hercules—or Jupiter ! ” or by one god or a dozen, according to the refined taste of classic antiquity.

It was not so very bad in them, because one cannot take Jupiter’s name in vain, for he is “ *non est inventus* ” himself ! But

familiarity with oaths, orgies and profanity makes it easy to take His name in vain, and *this* is very bad indeed. Think of it as you may, the habit of swearing, akin to that of lying, weakens and shatters the intellect. Oaths and lies are the very worst of all written or spoken words. No person can indulge in either without feeling the indignant lightnings—not very far off.

But let us render unto Cæsar, or the classics, the things that are Cæsar's, and honor to whom honor is due. The doctrine of Homœopathy, "like cures like," is everywhere true. The study of ancient languages gives us facility of expression in the use of our own language, and leads us to the best choice of words. Let it be so. We will use them for this purpose. Study them as aids to our own; use them as a rasp to sharpen our mother tongue—a work which they will accomplish, no matter what they fail to do.

The refinement and culture, we seek for, are not traceable to the study of languages. They come from the manners of our teachers at home, in the school, college, or university. Their source is the daily manifestation of a True Life, compelling our constant respect and reverence by unselfish devotion to us as students; by patiently guiding us to new and better views, and leading us on to new victories and triumphs of mind over matter — of the spirit over the forces of Nature. There is no sense of delicacy finer than our feelings towards such teachers. "By this they conquer," and hence we derive the amenities and refinements of academical or even classical education.

Without this personal power of mind over mind, to lift as well as lead; this moral magnetism of self-governed as well as scientific and classical teachers, whose Presence and Being are an unfailing inspiration and encouragement to virtue, our colleges and universities would be to-day but little better than the temporary abodes and theaters for Bacchanalian revels, so minutely described in the precious text-books of the course. Arnold, of Rugby, Horace Mann, Mark Hopkins, Alexander Campbell, Louis Agassiz, Benj. Silliman, Alexander Von Humboldt — what student ever went out from the presence and instruction of such men without knowing, if not realizing, that these premises are absolutely true?

In the great Mississippi Valley — (in which North America is principally situated) — we demand a more ample and practical system of education ; and not only so ; we will have it !

We will not complain of the last remaining fetters imposed upon us by the aristocracy, which provided for an excess of monastic learning in the colleges of Europe and America. It was the best they knew one hundred years ago ; but to-day we know better. Besides, these fetters are crumbling piece-meal — probably from rust. Nor will we complain of the tenacity with which most of our Eastern colleges pursue the study of languages — like their transatlantic progenitors. Moss and mistletoe are not so sacred to us.

The advance made in those institutions towards practical learning within twenty years is indeed wonderful. We do not want all they have ; but we want the best they have added to the new demands of the West.

Hence the emphatic decision recently given by the members of this House on this momentous question. That decision is as follows :

We will promote that system of education in Missouri which bears most directly upon the leading interests of the State ; or, in still more definite language, we will have an Agricultural and Mining school, well endowed with lands and funds, and what is better, well manned with competent instructors.

The highest prize for farming and mining ! Well done, Missouri. May your broad rivers bear the tidings onward to the Gulf, and the Atlantic, and, mingling the tides and currents, with this news reach and refresh the shores of distant nations, eager to follow your example !

The establishment of an Agricultural College in the State of Missouri, with a Mining School in Southeastern Missouri, is the dawn of a new era in our educational history. It is an expression of the people declaring that we have mining interests in this State, which are not secondary to agriculture, and which require special culture in order to develop them profitably. The forces which have carried forward this scheme, and procured its adoption by the representatives of the people of Missouri, have been collecting and

concentrating during the last twenty years ; and they spring from a steadily increasing conviction or knowledge, that the commonwealth of Missouri is most amply and wonderfully endowed with mineral wealth. Among the wonders of the world—known of both hemispheres, and described in many tongues, are the Iron Mountains of Missouri. There is not a school boy in all the land who does not know something about them, and he will tell you more of Pilot Knob, Iron Mountain, and Shepherd's Mountain, than of any other locality celebrated for minerals on the Globe.

The Institution, properly called the School of Mines, declares a determination to know the principles of mining, and to apply the same to productive industry, in order to open new avenues of wealth to our enterprising citizens. Those who attend the institution will be provided with means of instruction in Mineralogy, Geology, Chemistry, Metallurgy or assays, according to those methods which give the most profitable results.

The most useful, and also the most conspicuous of the Mining schools is situated in the center of the richest mining district of Europe—among the Hartz Mountains of Germany, at Freiburg. The instruction, practice, theories, and results of this school are the basis of mining operations wherever skill accompanies intelligence. By its thorough course of discipline — familiar every day companionship with the vast treasuries of ores ; the student is constantly challenged to seek out still better modes, leading to the best results.

A traveler has recently described it as follows :

“The Royal Saxon Mining School, now ninety-seven years old, is situated at Freiburg, twenty-five miles southwest of Dresden. It is surrounded for miles, by mines, chiefly of lead and silver, that have been worked for six hundred years, and is within two or three miles of two large smelting works. The smelting works near Freiburg, and some of the mines belong with the school to the government, and the rest of the mines and furnaces are wholly under government control. Students not only visit these mines and furnaces, but work at them—the oversight of these establishments being given to the Saxon graduates of the school ; constantly employing large numbers of them.”

Paris, London, Berlin, and other European cities have also their Mining schools. So we have scientific and polytechnic schools in many of our cities but in either case it has always been difficult to create and maintain a sufficient degree of enthusiasm to carry the student through the course. It is impossible to concentrate the attention of pupils by mere objects or specimens which are far removed from their source.

A series of samples of Iron ores from Iron county, or of Lead from Potosi or Granby; however much we may be delighted with their brilliancy, have a real interest only in connection with the formations containing them, because with the latter are involved the principal difficulties which require to be overcome.

The study of such formations gives the mind facility, or quickness in judging of the richness, or the quality and quantity of the ores therein contained. It is necessary, therefore, both, to study and manipulate ores in the region where they are found. To teach swimming does not require the discussion of theories, or a knowledge of the history of swimmers, but it does require proximity to a body of water. The State Mining School could not have a better location, and we predict for it a successful career.

To sustain such schools and make them easily accessible to the youth of the land—and to place the State under such inspection as we have set forth, requires a large expenditure, and this, with some, will be, at first, an objection; but finally, none will oppose these measures. The State of Pennsylvania may be cited as an example of increased prosperity, brought about by minute surveys of her Coal and Iron fields. Her shipments of coal were:

In 1820.....	365 tons.
In 1830.....	174,374 tons.
In 1840.....	841,584 tons.
In 1850.....	3,176,537 tons.
In 1860.....	8,151,569 tons.
In 1870.....	15,000,000 tons.

The shipments and home use of Iron exhibit a corresponding rate of increase.

Do the taxes on the increased valuation of her mining property pay the expense of her surveys? Aye, a thousand fold!

In other words, Pennsylvania enjoys an annual income of \$100,000,000 from the development of her mines of Iron and Coal—and this we declare to have been brought about by her thorough public surveys. The State of Missouri affords a larger and richer field than Pennsylvania. Besides it commands 23,000 miles of river navigation, and better than this, her position is the heart of the Empire itself.

One word more. The State of Missouri contains 42,000,000 acres of land, and it may be said generally that every section of this rich domain is supplied or dyked with mineral ores or underlaid with strata of coal. Is it too much to say that the proving of this statement to be true—a most delightful task—and the publishing world-wide of the verified facts, would enhance the value of every one of these 42,000,000 acres by the amount of at least \$1 per acre?

No one can doubt this result, and what constituency would not instruct and urge immediate action?

II. COAL AND IRON.

It is our purpose on this occasion to trace the rise and progress of the Coal and Iron trade from its rude beginnings, in order that we may properly understand its importance and govern ourselves wisely as to our own duty in these premises. A new era has dawned upon the world, and we are its ushers.

It is an era of progress, based upon the uses principally of Coal and Iron. Its climax is in the universal application of steam to the doing of the world's work, in the general departments of Agriculture, Manufactures, and Commerce, in order that Man may have opportunity for his highest development. The power which shall bring to pass this grand millennium lies latent in a drop of water, which a grain of Coal will start into such fierce action that the strength and resistance of Iron are required to curb and direct its scarcely awakened energies.

We shall also see from this discourse how abundantly we have been favored with the materials for present and future prosperity, and upon them as a basis we shall anticipate our national progress.

We will not enter upon this history of the riches of the Earth that we may be pleased with its glittering array, but rather that in earnest we may know how to shape our destiny, and discharge the responsibility which this knowledge will bring upon us.

Of the material furnished us for manifold uses, we have chosen Coal and Iron, as affording us illustrations of the prosperity that follows industry directed by intelligence. We find them closely associated in Nature. The great coal fields have large iron deposits near at hand. The State of Pennsylvania, whose coal and iron trade are world-renowned, is a good illustration of this rule.

In the same hill or mountain, over many thousand square miles of that State, one can frequently see coal and iron mining at one

view. And in the vast iron marts of England, Scotland and Wales, the smoke of the iron foundry and colliery ascend together and darken the same sky.

In early history no definite mention is made concerning stone or pit coal—distinguishing it from charcoal ; and it is not until the thirteenth century that coals were mined in a systematic manner. King Henry III. granted a charter, in 1239, to the people of Newcastle-on-Tyne, but the use of this product soon became known in London, whose citizens complained bitterly of coal smoke, and made remonstrances and petitions to have the nuisance abated ; and in 1306, in answer to petitions signed by Parliament, King Edward I., “ by proclamation, prohybited the burneing of sea-coale in London and the suburbs, to avoid the sulferous smoke and savour of the firing, and commanded all persons to make their fires of wood.”

But wood became scarce, the odious “ sea-coale ” sailed up the Thames again, and found a place upon the king’s hearth, twenty years after the veto was proclaimed.

In Germany, coal was worked as early as the tenth century, and in 1348 the metal-workers “ were forbidden to poison the air with coal smoke.” In Scotland and Wales, coals were used in 1300. It is probable that necessity compelled men to seek for a kind of fuel which could take the place of wood.

Coal was first applied to the manufacture of glass in 1619, and in 1635 King Charles prohibited the importation of foreign glass, setting forth in the royal proclamation that “ Sir Robert Mansell had by his industry and great expense perfected that manufacture with sea-coale, or pit-coale, whereby not only the woods and timber of this kingdom are greatly preserved, but the making of all kinds of glass is established here, to the saving of much treasure and the employment of great numbers of our people.”

This sounds very like an argument in favor of protection ; but the English are such valiant free-traders that it is ill-timed to make the suggestion.

Coals were used mainly, however, for domestic purposes, and there are no data by which we can ascertain the amount exhumed ; but the shipment received at London and the east coast, in 1704,

was 647,344 tons, sent from Newcastle and Sunderland. In 1750, from these two ports, the shipment was 1,193,457 tons.

It would be most interesting, but our limits do not permit, to show the impetus given to the coal trade by the discovery of its new uses and applications. The invention of the steam engine, and the demand of coal for steam, in the year 1700; the development of FORCE, instead of HEAT; the use of coal for gas, in 1803—not including the more recent uses—these have called up from all the coal treasures of civilized countries an amount which seems almost incredible.

The introduction of the hot blast in iron furnaces, by Neilson, in 1830, compelled the increased consumption in Europe and America. It was intended to save fuel, but it caused the erection of thousands of new furnaces, and since this period the statistics of the mining of coal are astonishing. We have derived this formula for the history of coal in its applications, “that every advance which tends to cheapen the productions of manufacture enlarges so widely the field of operations, that coal, the basis of the whole of them, is always demanded in ever-increasing quantity.”

In 1829, at the Clyde Iron Works, Scotland, it required eight tons and 125 pounds of coal to make a ton of pig-iron. By the hot blast, only five tons, 325 pounds were used for a ton of pig-iron. In 1833, by using raw coal in the furnace, instead of coke, one ton of pig-iron was made with two tons, 550 pounds coal, adding 800 pounds used in heating the blast, gives two tons, thirteen hundred-weight for one ton of Scotch pig-iron.

The increased production of iron was enormous — *i. e.*, in Scotland :

In 1820 it was.....	20,000 tons.
In 1830 it was.....	37,500 tons.
In 1839 it was.....	200,000 tons.
In 1851 it was.....	775,000 tons.
In 1861 it was.....	950,000 tons.
In 1864 it was.....	1,158,000 tons.

The amount of coal used to make 20,000 tons, in 1820, was 161,250 tons, coal; and to make, in 1864, 1,158,000 tons iron,

2,621,671 tons of coal were used, but the saving of fuel, in the latter instance, was 7,000,000 tons of coal, to be credited to the hot blast improvements of Neilson.

The consumption of English coal was :

In 1800.....	10,000,000 tons.
In 1859.....	42,000,000 tons.
In 1853.....	56,550,000 tons.
In 1854.....	65,661,401 tons.
In 1865.....	98,000,000 tons.
In 1869.....	125,000,000 tons.

30,000,000 tons are allowed as the annual waste for the year ending 1869, making the total consumption of coal, or exhaust of the coal fields, 155,000,000 tons yearly.

The United States contains over 275,000 square miles of coal surface — that is, surface beneath which may be found from one to ten strata, or beds of coal. These great deposits, or basins of coal, are mostly within the Northern States, as the following estimates will show :

The Illinois coal field, including a small portion of Indiana and Kentucky, contains 55,000 square miles. The Missouri and Iowa coal field occupies 50,000 square miles. This embraces Northern Missouri and Southern Iowa. Michigan possesses 12,000 square miles of coal area. The Eastern or Apalachian coal field is divided, as follows :

Pennsylvania.....	16,000 square miles.
Ohio.....	12,000 “ “
Maryland.....	500 “ “
Virginia.....	20,000 “ “
Kentucky.....	6,000 “ “
Tennessee.....	4,000 “ “
North Carolina.....	250 “ “
Alabama.....	4,000 “ “
Georgia.....	150 “ “

In addition to these, we must allow for the Kansas coal field, including the Indian Territory, 20,000 square miles; while the

great Colorado coal field (Cretaceous) occupies 100,000 square miles.

In comparison with these, let us notice the European coals. The estimates are as follows :

Great Britain contains.....	12,000	square miles.		
France	"	 1,719	"	"
Spain	"	 3,000	"	"
Belgium	"	 578	"	"

The rates of consumption of foreign coals have led political economists to inquire how long Europe may use her own coals.

"It is evident," says an English writer, "that although our favored country has so long taken the lead, all civilized countries have entered into the race of competition, and it becomes a matter of anxious inquiry to learn under what circumstances the treasure is in each country developed, and where it is likely to be best expended or longest economized."

This question is more fully stated in the same treatise on English coals, as follows :

"Knowing, therefore, most of the edges, and pretty nearly the depth, of all our recognized stores of coal, let us remember at what rate we are digging them out. The amount of coal raised in this country in 1864 shows that, supposing 1,300 tons be obtained per foot thick per acre (out of 1,600 which it actually contains), there are now clearing out, in every hour, day and night, for every day in the year, four acres of coal of two feet thick—one acre in every quarter of an hour ! There can here be no reproduction—nothing to grow again. 'We are drawing,' as an able writer has well put it, 'more and more upon a capital which yields no annual interest, but once turned to Light, and Heat, and Force, is gone forever into space.' How fares it with some of our best known districts ?

"It seems that in twenty years, ending 1860, the quantity of coal raised in Great Britain was more than doubled ; but are we thence justified in believing that in the following twenty years it will be again doubled, and so in geometrical progression ?

“On this view of the subject, little more than a century would see this country utterly deprived of the mainspring of its mercantile greatness.

“Manufactories without their motive power—Iron-furnaces blown out—railway trains brought to a stand still, steamers replaced by sailing ships—our streets left to the gloom of oil lamps, and our fire-grates empty—such would be the dismal prospect of a near approaching time, could we give credit to such an inference !

The following table shows the coal production of Great Britain :

	TONS.			TONS.
1854...	64,661,401,	of	which were exported...	4,309,255
1855...	64,453,050,	“	“	...4,976,902
1856...	66,645,450,	“	“	...5,879,779
1857...	65,394,707,	“	“	...6,737,718
1858...	65,008,649,	“	“	...6,529,483
1859...	71,975,756,	“	“	...7,081,949
1860...	83,208,581,	“	“	...7,412,575
1861...	85,635,214,	“	“	...7,221,718
1862...	83,638,138,	“	“	...7,694,558
1863...	88,292,215,	“	“	...7,529,341
1864...	92,787,873,	“	“	...8,063,846
1865...	98,150,587,	“	“	...9,170,477
1869...	125,000,000,			

In France it has been observed that the production of coal has similarly been doubled after every period of twelve to fourteen years, thus :

YEAR.	TONS.
1789.....	250,000
1815.....	950,000
1830.....	1,800,000
1843.....	3,700,000
1857.....	7,900,000
1863.....	10,000,000

These alarming results have caused recent and special surveys to be made throughout Great Britain, to ascertain the amount of coal,

including veins of twelve inches thickness, which a conviction of the scarcity of coals already compels mining both in Britain and on the continent. And although the amount in store is said to be 80,000,000,000 tons, it is not probable that one-half of it will ever be exhumed; so that with the increased exhaustion of British collieries, soon reaching 200,000,000³ tons annually, 250 years will be near the limit of total exhaustion !

The total amount of coal in the United States and Territories, if exhumed and placed in mass at the surface, would be equal to 2,000 cubic miles. Now, one cubic mile contains 7,000,000,000 tons, and our present Supply is 14,000,000,000 tons. Our yearly consumption of coal is nearly 20,000,000 tons, whence it is readily seen that the American coals will serve, at the present rates, 700,000 years — a conclusion quite satisfactory to our young and ambitious countrymen !

And as we complain of the temporary advantages of foreign labor and capital in the marketing of the products of Coal and Iron within our borders, we may safely anticipate the time when this country will furnish fuel to Europe to propel her ships and factories, and to light her hearth and forge-fires, — another satisfactory conclusion !!

The question naturally arises, what quality gives to Coal its value eminent over all other natural products of this class ?

We reply, that coal contains the greatest store or amount of heat in the smallest space, and yields it in the largest quantities, at the least cost, and besides is most universally distributed through all countries. It is, in short, the cheapest source of that wonderful power, STEAM, which is the basis of the world's progress ; and upon this, more than any other quality, rests its present estimation among civilized nations. But its great range of heat is another important fact in this connection. It spans nearly the whole catalogue of Minerals, of which the earth's crust is composed. It will smelt, refine or volatilize all metallic ores, and has a residue left that will not be economized until we have gone farther into the realms of Discovery and Use.

Like the steam, into which form it compels water, its range is illimitable. We stand only upon the boundary of this Enchanted

Land, and are voluble in our vain-glorious boasting that we of the nineteenth century are so soon to arrive at the climax of invention and enjoy the ripest fruits. But not so. We have used yet only the boyhood strength of steam.

We get an occasional hint as to its real power, when we find the far-separated fragments of boilers burst by superheated steam—having a power one hundred fold greater than our present uses require.

But let us inquire more closely. By the combustion of dry wood we obtain

Heat (Fahr.).....	2,867°
Turf will yield (Fahr.).....	2,732°
Bituminous coal, “	4,082°
Anthracite “ “	4,170°
Coke, “	4,352°

The melting point of iron, the most useful of the metals, is 3,479° (Fahr.), far beyond the heat power of wood, and within the range of Coal, giving the latter dominion over Iron, in all its ores and forms, with a surplus power of nearly 1,000°.

Had the heat power of coal been limited 1,000° lower, or the melting point of iron established 1,000° higher than it is, the entire Human Race would have been savages or barbarians until this day—shut out, too, from all improvement, as far as we now can see. To obtain a closer idea of the heat power resident in coal, let a person consider—as he puts three tons of it away in a cellar—that it contains a power greater than he can exert by working ten hours per day during a life of three score and ten years!

Rising with the power thus conferred upon Man, by his discovery of these relations and uses, we find in Great Britain, on sea and land, 100,000 steam engines, whose aggregate power is equal to the muscular force of 12,000,000 of human beings, working ten hours per day!

Now, making an estimate for the whole number of steam engines in constant operation, in all countries, on ship and shore, in factories and on railways, we shall find that their combined power is equal to the aggregate muscular power of 500,000,000 of men!

The day is not far distant when Coal shall thus furnish force or power adapted to every conceivable need, and equal to the united energies of the entire human race!!

Familiar with it for years, we cannot yet properly estimate or realize this power.

Setting one thousand millions of human beings free from the burdens for ages of consuming, wearying toil—is not this liberty to the captive upon the grandest scale ever witnessed or conceived? Do not the oppressed, indeed, go free?

With this all potent force, to dig and fashion, spin and weave, build our houses, and cultivate our farms—toiling and watching day and night as a faithful servant, with a thousand eyes and hands, what shall be our Country's progress during the next two centuries?

We have said that we are living early in the morning of the day of progress, whose avant couriers are Coal, Steam and Iron. Let us consider.

The first locomotive or "mechanical traveler," as it was named by its inventor, William Brunton, in 1823, moved on a tramway at the rate of two and one-half miles per hour, with a load of thirty tons. In 1838, Robert Stevenson's engine "Rocket," ran at an average of fifteen miles per hour.

Recently, engines have been made to travel seventy-five miles per hour. One engine, weighing fifteen and three-quarter tons in Pennsylvania, hauled 1,268 tons (a train of 158 cars of coal, 2,020 feet long) eighty-four miles in eight hours.

But we are using now only 100 to 120 pounds of steam per square inch of cylinder, or piston-head. When we have constructed steel boilers of one-half to five-eighths thickness and raised steam to 500 pounds and 700 pounds per square inch, with cylinder and enginery in proportion, it is hard indeed to say what may not be done.

We cannot better conclude this portion of our subject than to introduce the appropriate remarks of Francis Jeffrey.

"The steam engine has become a thing stupendous alike for its force and its flexibility, for the prodigious power which it can exert and the ease, precision and ductility with which it can be varied, distributed and applied. The trunk of an elephant that can pick

up a pin or rend an oak is as nothing to it. It can engrave a seal and crush masses of obdurate metal before it; draw out, without breaking, a thread as fine as gossamer; and lift up ships of war like a bubble in the air. It can embroider muslin and forge anchors; cut steel into ribbands and impel loaded vessels against the fury of the waves and winds.

"It is our improved steam engine that has fought all the recent battles of Europe, and exalted and sustained, through the late tremendous contest, the political greatness of our land. It is the same power which enables us to pay our national debt and to maintain the arduous struggle in which we are still engaged with the skill and capital of countries less oppressed with taxation."

But these are poor and comparatively narrow views of its importance.

It has increased indefinitely the mass of human comforts and enjoyments, and rendered cheap and accessible, all over the world, the materials of wealth and prosperity. It has armed the feeble hand of man, in short, with a power to which no limits can be assigned; completed the dominion of Mind over the most refractory qualities of Matter, and laid a sure foundation for all those future miracles of mechanical power which are to aid and reward the labors of after generations.

In the use and economy of our coals for iron making, it is a fact that the faults most complained of are not in our coals, but in ourselves. We do not eat bread made of straw, chaff, and bran, but rather, we thresh, and winnow, and grind until we have superfine flour. We have learned to do this uncomplainingly, knowing the inevitable accompaniments of the raw material; and in like manner when we inspect, select, and improve, by the cheapest and simplest methods, our American coals will everywhere be found to answer every possible demand in the manufacture of Iron.

Nothing is more common in the West than the unqualified abuse heaped upon our Western coals. And I claim it a special honor to fight as a volunteer on every occasion of this kind, and vindicate the character of King Coal in the Mississippi Valley.

Our repugnance to sulphur is unavoidable, for our memories respecting this element are often unpleasant, and our anticipations

still more so ; and when used either in the stove or furnace the result is not only unpleasant, but ruinous.

But no coals exist without sulphur except charcoal. It is also an inevitable accompaniment, but disposed and distributed in such a manner, and so readily volatile and easily removed, that it becomes a left hand compliment to any person, finding fault with our coals, in this regard at the present time.

The heat either of the steam or hot blast will soon be introduced into the smelting furnace, and dispel from coal every vestige of sulphur.

We said in the preceding lecture that the entire area of Missouri, with a trifling reserve, was occupied either with the Coal measures, or devoted to dikes and placers of useful minerals. In many instances, south of the Missouri river, both these values occupy the same district.

The coals of Middle and Southern Missouri, were formerly more extensive and continuous than now appear. The upheaval which gave us the Ozark range and its numerous spurs and anticlinals ;—dividing, breaking, and filling the whole area with mineral veins and masses—disturbed and probably carried away a considerable portion of the coal deposits, involving at the same time large masses in the pocket-form, as we now find them. Another portion yet remains, bearing marks of the former disturbance by its upturned and distorted strata, affording in many counties of Southwestern Missouri, enough for all needs, accessible by merely drifting, instead of the more expensive methods of shafting. As the result of those fierce physical movements, a much larger amount of coal than we could suppose, has been thus shut up in pockets, some of them having a depth of 50, and even 75 feet, and several hundred feet in extent. Also among the breaks of Eastern Missouri the same phenomena occur. They constitute a peculiar feature of the Coal system of Missouri. Several of them are now worked on the line of the Pacific Railroad ; others have been found on the line of the South Pacific, and one is known to exist farther south, towards the Ozark range. It is probable that many more will be found in Southwest Missouri, containing each, at least, 1,000,000 bushels of coal. Within a few years coal has been found along the entire

course of the Osage river, and most of its tributaries. Four different veins appear to be well defined—having a thickness of 2, 4, 5, and in many reported instances of 6 and 7 feet thickness. Explorations, systematic and thorough, will develop a still greater amount in many parts of the State, and we shall see that in Missouri as well as Pennsylvania we have both ores and coals associated.

We have already referred to the middle portion of North Missouri as being the central axis of a very extensive series of coal deposits, and estimated the Chariton coal as extending 30 miles in width by 150 miles in length.

Allowing only one workable vein, this area gives 18,682,933,000 tons, supposing the stratum now being worked to maintain four feet thickness, to say nothing of the three smaller veins overlying it.

Valued at half a dollar per ton, the amount is nearly \$10,000,000,000—one of the smaller items in the inventory of the mineral wealth of the State of Missouri. Mined and transported by railways at the rate of 1,000 tons per day, it will serve for a period of 2,770 years.

Unite the coals of North Missouri with the ores of the southern half of the State; connect them by railroads; bridge the Missouri with iron spans, so firmly that the northern half will never again think of secession. A mutual prosperity will thence arise to bind and unite stronger even than Iron bands!

We may safely assume that the earth will continue to be and appear, in its present condition, for and during a period of years, long enough to use the supply of coals—notwithstanding modern prophecies and visions; because these “black diamonds” cannot and will not be wasted.

Every ton of these coals is for man’s use. They were laid down in the waste places of the earth, long ago, in the middle ages of geologic history, and were slowly accumulated through processes that cleaned the earth of its poisonous carbon—storing it safely in permanent form, as we now behold it in every coal vein of the earth’s crust. The tiny plant, whose transformation has become coal, is microscopic, and the forces or agencies employed were silent

and obedient to the plan, whose unity was preserved through centuries, and whose results concentrate only in Man—a work that was prophetic of us millions of years before the Human Race appeared upon the face of the earth!

It is estimated that the amount of heat contained in coal is the precise amount derived from the sun during the successive summers of its surface existence, and that by combustion we restore exactly this amount, to be used again in the world's vast laboratory. Truly, there is nothing lost!—not an atom of matter, nor a pulsation of force. The hairs of our heads are numbered, and who can say there is no record of our thoughts and deeds?

New uses of coal are constantly being developed, so that, familiar as we are with it, it is still the greatest wonder in our midst.

We shall notice only two of these, as our limits and your patience are already trespassed.

“The once useless and fetid products of the distillation of coal have been made to yield sweet scents and savors. From its naphtha are obtained the paraffine oil, and the beautiful translucent solid paraffine, which in brilliancy and beauty exceeds wax itself, and from its aniline are obtained a galaxy of colors, among which we need only mention mauve and magenta.”

Can we say that in the nineteenth century, the gayest and richest colors that clothe and adorn the beauty of our land—richer than Tyrian purple or Damascene gold—colors that flash and dazzle in every assembly of fashion, were once the veritable rainbow colors of the sun, as it shone millions of years ago upon the tropic and microscopic vegetation which has been transformed into strata of bituminous coal? Surely the day of miracles is not past, but remains forever with us!

The second of the new uses referred to is to the combustion of coal-oils—for the generation of steam, thus avoiding the tonnage and transportation of coal.

It is estimated that crude oil may be used both for locomotives and steamships, as well as for domestic purposes, in countries where coal does not exist—saving nine-tenths of the costs of carriage.

It appears improbable, however, that either the oil extracts of coal, or any other form of hydro-carbon, will supplant the use of coals. The most we can expect from the combustion of oils, is to supply the heat of flame, which comes from the volatile portion of coal, the stronger heat being in the fixed carbon, which is obtained in the coke or fixed-carbon portion of coal, and is the result of the second burning or oxidising of coal—having already a red or white heat.

The flame, which is all that the oils can supply, we judge to be quite limited in its amount of heat, and insufficient for the rapid generation of steam and the maintaining of a high degree of pressure, and therefore incompetent for heavy service. We must largely use our coals in their present form, improving them by inspection, and by process of cleansing, coking, etc., etc.

Successful experiments have recently been made in Missouri to use the better class of bituminous slates and shales in making steam, by means of a grate adapted to the peculiar nature of slates.

With the simple apparatus used, 40 gallons of water at the ordinary temperature, was raised to 212° in 15 minutes.

The large amount and general distribution of rich bituminous shales and slates, in districts where the true coals do not abound, indicates another supply of fuel hitherto ignored, but economical only in regions where coal does not exist under workable conditions.

Great improvements are also being made in the manner of using coals, with reference to complete combustion, insisting upon the entire consumption of all smoke and gases by such modifications of the fire-box or grate, that the atmosphere shall be supplied in precisely such proportions as the constitution of coal demands.

These improvements have been carried so far that one ton of coal, which formerly would serve a train for 25 miles, can now be made to haul the same train 50 miles.

It is true that much depends upon the quality of coals of respective localities. Thus we find that from a certain mine that 1

lb. of coal will evaporate 7 to $7\frac{1}{2}$ lbs. of water, while another lb. of coal will evaporate only 6 to $6\frac{1}{2}$ lbs. of water.

Experiments with coal and wood, comparatively, as fuel, whether for steam or domestic uses, show a great economy in the use of coal over wood at ordinary prices. It is estimated that one ton of coal is equal to $2\frac{1}{2}$ cords of average or mixed wood, or two cords of best wood—a result, as will be readily seen, of the superior heat power contained in coal.

On locomotives the advantages of coal over wood has been variously estimated. The ratio of 26 to 17, established by the Illinois Central Railroad, exhibits, doubtless, the average superiority.

Having already referred to the more striking features of the mineral wealth of Missouri, we will now consider the extent of recent discoveries. The astonishment, natural to every person after beholding the three mountains of iron in Iron county, already noticed, leads him to suppose that we may not again expect a similar display. But we find, upon search, that these gigantic masses are not a hundredth part of the accessible iron ores, of the same quality and similarly disposed, in twenty-five or thirty counties of Southern Missouri.

In February, 1869, the first ore bank was purchased, near Cuba, Crawford county. The partial development of this ore led to the discovery of other iron deposits in the vicinity. There are now known to be ten workable beds of red oxide, blue specular and hermatite varieties, within a radius of three miles from Iron Center (a station on the South Pacific Railway).

A shaft forty feet deep was made in this iron bank, passing twenty-five feet through red oxide and specular ore—the last fifteen feet being massive, and requiring the force of powder in quarrying the ore.

At Cuba, four hundred tons iron ore are ready for shipment. Twenty tons are raised daily—one hundred tons could be as readily raised.

At St. James, iron has been worked successfully forty years, in charcoal furnaces. The supply of coal is unlimited.

In the vicinity of Rolla, large iron masses and dykes have been discovered. Transfers of iron lands are constantly being made at high prices, indicating that the ore is sufficiently magnetic to draw the iron masters of Ohio and Pennsylvania, and even of England and Germany, to more inviting fields than their own.

Twelve distinct banks have been discovered and reported in the Saline Valley, St. Genevieve county, and four in Perry county.

Two new banks are reported in Iron county, and several in places remote at present from any railroad.

Two new banks have recently been purchased on the extension of the Iron Mountain Railroad. In all these instances the ores are massive, both specular and hematite.

On both sides of the St. Francis river, for a considerable distance, are found extensive districts of excellent hematite iron. Fourteen localities have been noted, each sufficiently furnished with ore to maintain furnaces for an indefinite time. A railroad is under construction, I am informed, from this region to Cape Girardeau, in order to carry this ore to the Mississippi river, and return coal to the iron region.

The timber in the vicinity is equal to any demand that may be made for charcoal, which is known as the best fuel for working iron. It is most probable that a large proportion of the vast forests of Southern Missouri will be used for smelting and refining iron and other metallic ores.

The amount of charcoal which can be used in connection with the ores of iron and other metals, from forests in proximity to vast deposits of ore, and accessible both by river and rail, may be safely estimated at 182,000,000,000,000 bushels, allowing 300 cords of wood per acre, and 100 bushels charcoal to a cord of wood, on an area of 10,000 square miles.

Dykes or deposits of the same class of iron are found in proximity to both the Gasconade and the Osage rivers, and in some instances coal and iron are intimately associated. Perhaps 100 miles on the former stream and 150 upon the latter could be classed as productive iron districts. The same is true of the Maramec and other large streams.

Nor is it merely good fortune, that the railroads pass through rich iron districts. Construct railroads in any direction, and each one will have exhaustless iron within reach.

A thorough survey of the State would give us a system of these wonderful veins or courses of metallic ores, and lead to the discovery of a much larger amount than we have now ascertained.

A careful study of the distribution of minerals in all parts of the globe shows that order reigns everywhere. Minerals are surrounded with rock formations which are constant associates, and upon this order, science is founded. Those who have learned this alphabet of nature are quick to reach the most profitable conclusions.

It will be seen that the lines of anticlinals are marked and distinguished by a more uniform supply of ores. The reduction of iron from its ores and the various refining processes in its manufacture will oblige us to use our coals to an extent now scarcely apprehended, and in this manner the vast forests of Missouri will disappear. Dr. Smith, already referred to, says :

“The total production of the Durham or Northumberland field, which, in 1854, was 15,420,615 tons, is for the year 1864 no less than 23,284,367 tons. This enormous increase is in great part due to the rapid development of the Cleveland iron district, in North Yorkshire. The iron furnaces in the three districts fed with the coal from this field were, in 1854, as many as 58; in 1865 they were augmented to 105 actually in blast; and large quantities of Durham coke are now conveyed to the western coast for the smelting of the hematite ores. The total quantity of coal thus consumed is probably much more than doubled in one decemium.”

The smelting of iron ores in the furnaces consists simply in driving away the more volatile portions of the mixed ore, or in melting the iron out of the grasp of the more infusible parts. It is often found nearly pure; but it seems to be a law in the grand economy of nature, that, to keep and preserve the metals from oxidation or rust, they must be united with such other materials that the resulting compound or ore will have little or no affinity with oxygen.

By this means the ores of all metals are carefully guarded from destruction through the long ages that must intervene before man shall require them for their varied uses.

The most common forms of iron are the Hematite and Specular ores. The former is named from its red appearance; the latter from its crystalline structure. These occur principally in our mountain ranges, or districts which have been subject to volcanic agency.

We have also nodular ore, and band ore, the sulphurets, and carbonates, besides the *fossil* ore, as it is termed in Pennsylvania, being composed of small ferruginous shells, which lived in the waters of an ancient era, in such vast myriads as to form strata of iron-shell-rock many hundred feet in thickness.

Is it not marvellous, at least, that these tiny creatures should have been furnished with iron, instead of lime, for their masks or shells, so that he has become a special contributor to human progress a million of years since he ceased to exist!

"Practically speaking, absolutely pure iron has no commercial existence. But, on the other hand, extraordinarily small traces of foreign elements exert a very marked influence on the metal, and it is precisely these small, and, in many cases, unnoticed differences of composition that render so many points in the chemistry and practical working of iron obscure and difficult to be understood.

When it is considered that the investigation of such problems calls for researches involving the utmost refinements of analytical chemistry, it is not remarkable that contradictory statements and opinions still abound on many points of the chemistry of iron-making."

It is proper, at this point, to notice the extent and quality of other ores which are being discovered and marketed.

Zinc ores are particularly abundant. From one locality, five miles from the Iron Mountain Railroad, is derived all the zinc ore, used at the Carondelet Zinc Works. In Southeast Missouri it co-exists with lead, and both follow a general direction northwest to southeast, from the Virginia mines to Mine-la-Motte, a distance of seventy-five miles.

Copper has been worked from the green and purple oxides, found on Current River, tributary to White River, in Shannon county. In 1856 several hundred tons were sent to Baltimore from which copper was extracted.

Baryta, or heavy spar, which abounds in many counties, has an increasing demand.

From Cadet Station, Iron Mountain Railroad, in three years, 60,000,000 pounds have been shipped. It is worth \$9.00 per ton, and is largely used for white paint, and for many purposes hitherto served by ivory. It is also largely used to imitate white lead, or sugar and flour, and the temptations in this direction are stronger than human nature can bear. But such transactions are first-class forgeries, deserving both fines and imprisonment.

Since three years, great excitement has arisen from reported discoveries of tin in the region of Mine la Motte, and other localities. Large areas of tin lands were bought and sold, and numerous assays were made, assuring a per cent. of tin far greater than the yield of the Cornwall or Sumatra ores.

The English ores of tin, or "tin stone," are valuable, which hold one and a half or one and a quarter per cent. of metal, and are sought after in deep mines which extend 2,000 or 3,000 feet below the surface.

The Missouri "tin-stone" is said to afford from two to four per cent. pure tin, and the rock formation or lode holding it is said to be twenty to thirty feet in thickness, extending several miles. In one instance a dyke of "tin-stone" was found to extend through Reeves' Mountain, from base to summit, nearly 1,000 feet above the bed of St. Francis river. The ores of tin are as easily reduced as lead, but the price of tin is far greater.

Why are not these ores worked? is a question often asked. If they are so rich in tin, we have most certainly a monopoly of this article in Missouri. The whole truth is shrouded in mists, but the following letter from General Sherman, while "non-committal" in some respects, is, to my view, encouraging:

HEADQUARTERS ARMIES OF THE U. S., }
WASHINGTON, D. C., *Jan. 27, 1870.* }

J. P. MURPHY, Esq., *Jefferson City :*

DEAR SIR—Yours of Jan. 22 is received. I did visit the Tin mines near the Iron Mountain, and did have some assays made, both in St. Louis and in London.

These assays convinced me that the mineral was not rich enough to work, with the present cost of labor, &c.

This is as much as I am willing to say.

Yours truly,

W. T. SHERMAN,

General.

[Copy.]

At the Cannon (Tin) mines, in Washington county, \$82,000 have been already expended for machinery, buildings, fixtures, lands, &c., &c. Tin smelting will doubtless soon be commenced, and the Tin lands be placed upon their real merits, and be judged by their profits. It is quite certain, too, that deep mining will be as profitable in Missouri as elsewhere—whether it be for Tin, or Zinc, or Lead, or Iron.

Quite as important are the recent discoveries of gray and red Granite, under such conditions that extensive quarries can be opened, and Granite blocks of dimension size sent to any part of the country, or to the city of St. Louis. But, no! this stone is “rejected by the builders.” We must send to Scotland for Granite base-blocks or pillars, paying one thousand instead of one hundred dollars for an inferior quality.

Seven miles from Farmington, is a large quarry of Carnation Granite, of beautiful tint, and in extent, unlimited. It is capable of the finest polish, and will prove a most valuable acquisition to the City of St. Louis—in whose reconstruction, all are glad to see beautiful building stone used, instead of dismal, cheerless brick. The front pillars of a New York Jobbing House, from the Scotch quarries cost \$20,000, and single shafts for cemetery use, from the same source usually cost \$1,100. With the new process of quarrying, this rock can be cut or split in any required form. These Granites, gray, red, and carnation, deserve the immediate attention of architects and capitalists.

By the discovery of placers or dykes of metallic ores, a great value is immediately conferred upon lands.

Professor Shepard mentions an instance. A few hundred acres in Ohio—not worth one dollar per acre—by the discovery of band ore, was sold for \$30,000, and is now estimated at \$250,000. At another place a man asked \$300 for a small tract of Iron land; but the Iron-workers preferred to pay 10c per ton royalty for the ore. The amount thus paid, in a few years was \$4,000. In Missouri tracts of land, that were unsaleable at one shilling per acre—the purchaser having sympathy as the *bitten* party—cannot now be had for \$250 per acre. Sales are often made, of lands that have risen from \$1,000 to \$40,000.

In childhood we have seen light follow shadow across the meadow, or harvest-field; and it is not less delightful now, to see lands, long burdened by unworthiness, set free, and made not only respectable, but aristocratic. But we forbear. In the midst of such riches, hidden, but not unsearchable: a man feels like a beggar-boy in the Bank of England, with only a six pence in his pocket,

But if *we* can not enjoy we can, at least, be grateful for the limitless supply vouchsafed to coming generations, and with security interpret the vast supplies of Coal and Iron as mute prophecies not only of the permanence of the present order of things, but also, of the unexampled prosperity of our country.

There is Iron enough in the State of Missouri to build railroads, ten miles apart, all over the Earth, — cobweb the air with telegraph lines — span every river with Iron bridges, and supply ordinance and iron-clads for all nations during the next thousand years!

It is not proposed to take this contract just now; but simply to compete with other iron marts of our country, and manage to furnish a reasonable share of the present demand.

We may next consider the value conferred upon Iron by skill and industry. A locomotive, which weighs fifteen tons of Iron, is worth \$20,000. The value of the amount of Iron ore required in its construction is, perhaps, \$100! A pound of Iron will make 200 to 300 main springs, small size, and 80 to 100 per pounds large size.

From 200 to 400 hair springs, of smallest size, can be made from one pennyweight of Steel, which will also make 80 large size hair springs. A pound of Iron or Steel, Troy weight, will furnish, therefore, from 48,000 to 96,000 hair springs. The price of these articles varies from \$1.00 to \$3.00 per gross; very fine hair springs cost \$10.00 each. The price of main springs is, average, \$18.00 per gross.

A fine laminated steel gun-barrel—its raw material costing twenty-five cents—is worth \$30 to \$50.

In regard to the new uses and applications of Iron, let us notice the statement of one of the pioneers of railroads in the West, Mr. A. T. Hall, of the Chicago Burlington and Quincy Railroad, “that there is more room for progress in the perfection of railways henceforth, than the entire improvements made during twenty years!” Chief among these is the use of Steel rails, requiring for their production additional skill and capital.

We may notice, next in order, the condition of Iron manufacture in our own country, as compared with the Iron Manufactures of England.

The production of pig-iron in England and United States, from 1854 to 1862, was :

	ENGLAND.	UNITED STATES.
1854.....	3,069,838 tons.....	716,647 tons.
1855.....	3,218,154 tons.....	754,178 tons.
1856.....	3,586,387 tons.....	874,428 tons.
1857.....	3,659,447 tons.....	798,157 tons.
1858.....	3,456,064 tons.....	705,004 tons.
1859.....	3,712,904 tons.....	840,428 tons.
1860.....	3,826,752 tons.....	913,774 tons.
1861.....	3,712,390 tons.....	731,564 tons.
1862.....	3,943,469 tons.....	787,662 tons.

The amount for 1869 was, for England, 4,900,000 tons pig Iron!

The increased demand for Pig Iron in the United States is not far from 200,000 tons per annum, while our increased production

will average only 60,000 tons per annum. A deficiency of 100,000 to 140,000 tons yearly is therefore supplied from foreign Iron markets.

"In France, the annual product of Pig Iron was, in 1866, 1,253,100 tons, and, 1867, 1,142,800 tons, showing a decline of 110,300 tons.

"In Austria, the official returns of the Iron trade show a diminution of forty-two per cent. in 1866, as compared with 1860, and of sixty per cent. as compared with 1862."

The Iron production of the world for 1856, as stated by Mr. Hewitt, was as follows :

COUNTRIES.	PIG IRON—Tons.	WROU'GHT IRON—Tons.
England.....	4,530,051	3,500,000
France.....	1,200,320	844,734
Belgium.....	500,000	400,000
Prussia.....	800,000	400,000
Austria.....	312,000	200,000
Sweden.....	226,676	148,292
Russia.....	408,000	350,000
Spain.....	75,000	50,000
Italy.....	30,000	20,000
Switzerland.....	15,000	10,000
Zollverein.....	250,000	200,000
United States.....	1,175,900	882,000
Total.....	9,322,047	7,205,026

Including all classes of imported Iron. We give the following for the United States :

	1868.	1869.
Iron, pig and puddled.....	83,564	132,491
Iron, bar, angle, bolt and rod.....	38,200	51,738
Iron, railroad, of all sorts.....	255,462	294,369
Iron castings.....	1,213	1,677
Iron hoops, sheets, and boiler plates.....	15,999	31,292
Iron, wrought, of all sorts.....	4,020	7,364
Total.....	399,458	518,930
Steel, unwrought.....	14,847	15,612

As we look at these statistics of foreign importation of Iron, we are inclined to question the intruder, and enforce the provisions of the Monroe doctrine, which are neither latent nor dormant, among our citizens!

We are debtors now to Europe in a sum exceeding \$1,000,000,000, chiefly for Railroad Iron. It is not a National debt, strictly considered, but our railroads are bound for its payment. Foreign Capital thus dictates their management, and tells us both when we can ride and what we must pay per mile. It is not at all consoling to understand that cheap capital and labor enable English Iron Masters to impose this burden upon us, especially when we consider that our own ores produce Iron of far better quality, in the very districts traversed by English rails.

To-day, English Railroad Iron costs \$35 per ton in gold; the freight to New Orleans, \$5 per ton; duty, per ton, \$15.68; add 20 per cent. premium for gold, and we have the cost of a ton of railroad iron, in currency, \$66.12. The cost of American Iron is about \$85 per ton.

But why should this difference exist—a difference of nearly \$20 per ton, cheaper, in favor of English Iron?

We will answer, briefly:

The price or worth of money—three per cent. in Britain, and ten per cent. in the United States—makes our Iron cost \$5 more per ton than English Iron.

The capital of British Iron masters, accumulated through a hundred years of mining industry, enables them to lend money, in the form of Iron, at a small rate, and on long time.

We, from our recent beginnings, especially in the West, cannot offer such terms; and when we would grant *time* to consumers, or customers, the Englishman outbids us by his trump card of *eternity*! In other words, he says, "Pay the interest, merely; the Iron being used simply to create a permanent indebtedness!"

But the especial cause of cheap English Iron, is the cheap or low-priced labor of English operatives; and in this regard we have no desire to compete. We could not if we would. The condition of our country is such that both common and skilled

labor will command wages sufficient to give every laborer an independent home — and this, fellow citizens, is truly an American Institution!

We present a table showing wages paid to workers in Iron in England and Germany:

Wages Paid in South Staffordshire, England, in 1866.

	PER DAY.		
Common laborers.....	2s. 6d.	to	3s. 0d.
Puddlers.....	7 6	to	7 10
Puddlers' helpers.....	2 6	to	2 11
Puddle rollers.....	9 0		—
Heaters.....	7 0		—
Heater helpers.....	3 6		—
Finishing rollers.....	11 0		—
Shinglers.....	9 0	to	15 0
Machinists.....	3 0	to	16 0
Blacksmiths.....	4 0	to	5 0
Masons.....	7 6	to	8 6

The average price of skilled and unskilled labor at the iron works in England does not exceed 4s a day.

At the coal and iron works of Creed & Williams, in Belgium, the wages paid in 1866 were as follows:

	PER DAY.		
Common laborers.....	1s. 2d.	to	3s. 6d.
Loaders of coal.....	2 6	to	2 11
Wood-cutters.....	2 6	to	2 11
Wood or tree-setters.....	3 1	to	5 0
Miners.....	2 11	to	4 5
Exceptional men.....	5 0	to	6 0

At the Blast Furnaces.

Fillers.....	1 1	to	2 1
Box Fillers.....	1 4	to	1 8
Common laborers.....	1 5	to	1 8
Furnace-keepers.....	2 1	to	2 11

In the Rolling-Mill.

Puddlers.....	4	2	to 5	0
Helpers.....	2	3	to 3	1
Rollers.....	4	2	to 5	10
Helpers.....	3	4	to 4	5
Shearers	1	10	to 2	6
Common laborers.....	1	5	to 2	1

In all other European countries wages are lower than in England.

That is, 62½ cents day wages is paid common laborers; while the daily wages paid here will average \$2.00 !

As a consequence of low wages, and the tyranny of masters, we are obliged to infer the pauperism and crime and misery of hundreds of thousands who are too weak to resist, and too poor to come to a land where labor finds reward.

Reliable statistics show us that, in 1868, 500 families died of starvation in England. We can strive against such odds only in one way. But we have no disposition to appear in the arena where pitiless poverty and death, grim and gaunt from starvation, shall also have free course. We will fence out such unsightly apparitions and protect our manufactures, in order that we may honorably sustain our industry and give to every laborer such wages as may enable him to be a freeman.

The future demand for Iron may be anticipated from the progress of Railroad building since 1827 to 1870 :

Table showing the Annual Progress of Railroads Constructed in the United States since 1827.

YEAR.	MILES.
1828.....	3
1829.....	28
1830.....	41
1831.....	51
1832.....	131
1833.....	576
1834.....	762
1835.....	918

1836.....	1,102
1837.....	1,431
1838.....	1,843
1839.....	1,900
1840.....	2,197
1841.....	3,319
1842.....	3,877
1843.....	4,174
1844.....	4,311
1845.....	4,522
1846.....	4,870
1847.....	5,336
1848.....	5,682
1849.....	6,350
1850.....	7,475
1851.....	8,589
1852.....	11,027
1853.....	13,497
1854.....	15,672
1855.....	17,398
1856.....	19,250
1857.....	22,625
1858.....	25,090
1859.....	26,755
1860.....	28,771
1861.....	30,593
1862.....	31,769
1863.....	32,741
1864.....	33,860
1865.....	34,442
1866.....	35,351
1867.....	36,896
1868.....	38,822
1869.....	42,272
1870.....	48,860

There was an increase in 1869 of 6,000 miles, of which the total cost per mile is \$45,000; and the aggregate cost is \$2,198,700,000.

\$298,000,000 dollars were spent in 1869 in extending railroads. 13,446 miles are now projected and in process of building.

There were completed, in 1869 :

In the North Interior States.....	3,976 miles of railway.		
“ Middle Eastern States.....	1,026	“	“
“ Pacific States	922	“	“
“ South East and S. W. States ...	662	“	“

4,000 miles of railway were built in the upper part of Mississippi Valley in 1869, and 2,000 miles more to make Eastern connections, while only 600 miles were constructed in all the rest of the country.

These statistics show the effect of the Union Pacific Railway in stimulating other corporations to make connection with it in order to secure a share of the carrying trade across the continent.

In all 5,000 miles extra of railroads have been added as the direct impetus of the first road to the Pacific, which a few years ago was regarded as impossible, and whose projectors were considered insane.

The concentration of railroads from the Southern States, with those of the Middle and Northern States of the Mississippi Valley, at some point probably in the Indian Territory, uniting in another grand trunk route across the continent, on or near the 35th parallel, is an event which every person anticipates. The Kansas Pacific Railway is rapidly approaching the mountains, pushed with an energy that will find its way through, and across to the ocean. Add to these statements and statistics the fact that railroad iron must be supplied anew, or re-rolled, every ten years, and we may comprehend to some extent the trade and manufacture of iron, which ought to be American.

The locomotives and cars of Europe, would reach from St. Petersburg to Paris, being nearly 1,000,000 in number. The total length of Railways is 70,718 miles. The locomotives number nearly 20,000, and their combined work is a transit of 60,000,000 miles per annum.

The amount of Iron used for rails, is 7,500,000 tons, and the annual consumption of Coal is 4,000,000 tons.

In the United States, the amount of Iron laid down on Railways, is nearly 4,000,000 tons, of which we may estimate at least 3,000,000 tons as foreign Iron.

During the year past 65 new blast furnaces have been erected in 15 States. Of this number 6 are in New York, 1 in New Jersey, 19 in Pennsylvania, 1 in Maryland, 4 in Virginia, 6 in Ohio, 5 in Indiana, 3 in Illinois, 5 in Michigan, 2 in Wisconsin, 6 in Missouri, 3 in Kentucky, 1 in Georgia, 2 in Alabama, and 1 in Tennessee. From the new and old, our productive power is now increased to 2,500,000 tons per annum. Fifty additional furnaces are being erected this year, and our product for 1870 will doubtless reach 2,225,000 tons or half the production of Great Britain.

The present market price for American Pig Iron ranges from \$33 to \$35 per ton, to \$42 for best quality. The total cost of making Iron varies according to circumstances of ore, fuel skilled labor, and machinery which involves a large capital.

At Carondelet, the actual cost is as follows :

Fuel for ton of Iron.....	\$12 00
“ “ “ Ore.....	8 77
“ “ “ Lime.....	35
Labor and incidentals.....	5 00
	\$26 12

Add for Transportation.....	\$2 00
“ “ Commission.....	1 25
“ “ Interest.....	50 3 75
Total cost.....	\$29 87

In Indiana—Brazil.

Fuel.....	\$ 8 40
Ore, I. M. 1 $\frac{5}{8}$ tons.....	16 49
Lime.....	50
Labor &c.....	5 00
	\$30 39
Add marketing	3 75
	\$34 14

In Pennsylvania, in 37 Furnaces in the Lehigh, Schuylkill and Susquehanna regions, the cost of making one ton of Iron, was \$29 63, average for the last six months of 1869.

In Ohio—Southern.

Ore, 1½ tons Missouri Ore.....	\$15 00
Lime.....	1 50
Fuel.	9 00
Labor	3 00
	\$28 50

In the last two instances we do not know the cost of marketing.

We are therefore compelled to regard the statements of certain leading papers, that Iron is made at a cost of \$22 per ton, as unreliable; no matter how these estimates were obtained: and the statement that in Tennessee, Iron has been made for \$19 per ton, is wholly untrue, and could only have been made concerning those furnaces, whose proprietors have been obliged, from heavy losses, to suspend operations.

The shipment of Iron ore from Lake Superior Iron Mines, in 1868, was as follows:

Jackson	Mines	131,708 tons.
Cleveland	"	102,213 "
Marquette	"	7,979 "
Lake Superior	"	105,745 "
New York	"	45,665 "
Lake Angeline	"	27,657 "
Edwards	"	19,360 "
Iron Mountain	"	3,836 "
Washington	"	35,855 "
New England	"	8,257 "
Champion	"	6,255 "
Barnum	"	14,380 "

The shipment and distribution of these ores, however, over a distance of more than 1,000 miles, to meet, at a suitable place, the fuel for its reduction, must always prove a serious inconvenience

and loss, as compared with the Missouri ores, with coal and other fuel near at hand, and adequate, both as to quality and quantity.

The yearly consumption of Coal in St. Louis, is now 16,950,000 bushels, and the shipment of Iron ore by Railroad, from the various Iron districts, is nearly or quite 1,000 tons per day. Both these estimates will largely increase for the year 1870.

With facilities which Railways should be prompt to give for the speedy transportation of both Coal and Iron, and with the encouragement of these industries by the State, in every legitimate manner, and with the protection which justice demands, Missouri will become the first of the American States in the manufacture and commerce of Iron, and the consequent profits of Agriculture, and St. Louis at no distant day will be the largest Iron mart on the Continent.

APPENDIX.

DESCRIPTION
OF
South-Western Missouri and South-Eastern Kansas
INCLUDING

*Soils, Climate, Water, Drainage, Building Material, Fruits, and
other Products, Grasses, and Grazing, Railroad Lands,*

HINTS TO SETTLERS, &c., &c.

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Having made several examinations of the South-Eastern counties of Kansas and the South-Western counties of Missouri within the last year, having in view the topography of the country as well as its mineral treasure, I propose to write out, for the benefit of those seeking homes and investments, such facts as came under my notice.

The country under consideration lies south of the Kansas Pacific Railway, and includes that portion of the State of Kansas lying east of a line drawn south from Junction City to the Indian Territory, with the Counties of Jackson, Cass, Bates, Barton, Jasper, Newton, Lawrence, Dade, Cedar, Vernon, St. Clair, Henry, Johnson and Lafayette, in the State of Missouri. This survey also takes in the Cherokee Neutral Lands, the Osage Ceded Lands, and a portion of the Osage Lands proper. The district surveyed extends 175 miles north and south, by 250 miles east and west, and includes that portion of Kansas and Missouri towards which emigration is so rapidly tending.

This region is drained principally by the Osage, Neosho and Arkansas rivers, and their tributaries. The general direction of these streams will, therefore, give the slope or inclination of land, which can be specially determined for every section by reference

to any good geographical map of the two States. The best map now extant is Keeler's—Colton's or Blanchard's, however, will answer most purposes.

The most common enquiries relate to the basis of the country itself. What are its foundations? or rather the rock formations underlying its surface?

It is an established principle that soils take their character from the subjacent rocks, and with this in mind, the traveler may learn much of the rocky structure of any region, by noticing carefully the loose earth or soil at the surface. The geological formation to which this portion of the country is referred, is called Carboniferous, in which are found the Coal measures. A large portion of Eastern Kansas is upper carboniferous—sometimes called Permian. This extends beyond Fort Riley, near which the Cretaceous formation appears, and extends beyond Salina, where the tertiary series appears above it, and which extends beyond Phil. Sheridan and Fort Wallace, where the Cretaceous group again occurs and extend to the foot hills of the Rocky Mountains. The succession of these formations is like the courses of shingles in a roof rising westward. The overlaps are irregular, but they do not dip, as has been often stated in public reports. As the kernel is of more importance than the husk, so it is of more consequence to describe the valuable materials which these rock formations contain.

The common building material is limestone, of which there are several varieties, viz: yellow, white and brown—besides a coarse massive limestone, suitable for heavy work, such as piers and abutments for bridges. The Railroad bridge at Kansas City affords an example of this class of stone. A much coarser variety is found in large quantities, disposed in regular ledges, along the Neosho and Verdigris rivers. Small patches of it are also seen in the "border tier" counties, where it appears like the loose or lost rocks of the drift formation, while in reality it is the last remnant of a series increasing in quantity westward.

The Fort Scott Marble is an interesting variety of limestone belonging to the coal measures. It forms a ledge or stratum from six inches to thirty inches in thickness. It is very compact and hard, and is often affected by fractures and cleavage lines. It can

be quarried in masses and sawed into slabs for table tops and other cabinet uses. It is beautifully variegated with golden threads of every imaginable curve, which are the rims or edges of shells of various genera and species, inhabiting the waters in ages past, of the great Carboniferous sea. Another class of building material, called magnesian limestone, or Junction City Marble, is quarried and shipped extensively from Junction City, Kansas—near Fort Riley. It is very extensive, being from four to seven feet thickness, and forming a cap-rock of many thousands of square miles of Middle and Eastern Kansas. It not only quarries, but cuts easily, and is worked to any dimension required, by saws and planes. It is of light drab color and makes a beautiful front. The State Capitol, at Topeka, is built of it, and several new buildings and residences at Kansas City and Leavenworth are finished with this material. This limestone should not be confounded with the lower magnesian limestone so prevalent in the middle counties of Missouri—seen at various points on the Missouri river—the State Capitol being built of it: these belong to the lower Silurian division of rock, while the former are of the Upper Carboniferous or Permian series.

The sandstones are everywhere prevalent, but are abundant near the Missouri border. They alternate with limestone, in such a manner that the farmer may choose his material for house, barn, and fence. These sandstones are of various dimensions, and no part of the country is without them. It is worthy of notice, too, that both these classes of stone are near the surface, but not so near that they materially interfere with farming, nor so deep as to make extra cost in quarrying. The edges of these strata are seen in all directions wherever ravines, or creeks, or ridges or mounds mark the general surface. The rule pertaining to highlands or uplands is, that the cliff or edge separating them from the bottom lands is the outcrop of a persistent ledge, and on a strip not 60 feet wide, in nearly every township, are quarries that can never be exhausted, of the cheapest and best building material.

There is scarcely a section of land in this vast domain that is not supplied in this manner with one or both of the above described classes of stone.

The improvements already made are characteristic of the geology of the region. Stone fences, barns, houses and walks are common, and this material will continue to be used. Those who are wise will discard brick, because stone is cheaper and far more valuable, while for beauty or effect, all will prefer stone.

The water supply of this country is closely associated with the system of rocks, and is a natural consequence of extensive rock formations lying near the surface.

Who does not see that strata of limestone, sandstone or slate riven by fractures and separated by layers, forming innumerable crevices, will give rise to myriads of springs of the purest water?

This feature is so extensive that it is safe to say that no portion of the United States is so well watered as South-eastern Kansas, and South-western Missouri, excepting perhaps the Indian Territory.

It is also owing to this peculiar feature that the streams are for the most part clear as crystal; especially those flowing south and south-east, while those flowing into the Osage, passing through deep clay drift, though generally clear, are sometimes turbid.

Streams leading eastward are also slower while the southern streams are rapid, showing that the general average of surface, in lines drawn east and west, is nearly level, with a slight rise westward. The slope southward is far greater, and gives greater advantages for mills, factories, &c. The drainage system of this extensive region is so perfect that not an acre in a thousand is unfit for cultivation from excess of water. We did not see a swamp or marsh in our travels. Crossing the prairie in any direction, we find that the high grasses and reeds which generally indicate marshes, are nearly as firm as the uplands and ridges.

It is a wonderful system which thus provides for the drainage of every acre of land without loss! The solving of this problem indicates the highest Wisdom. Our preachers may here find new views of the Divine Goodness quite as practical as those sublimer views which often beguile our moral teachers of so much valuable time. This problem has been perfectly solved for the portion of Kansas and Missouri under consideration. In performing this stupendous miracle there could be only one result, viz. : a system

of rolling prairies! But lest we should seem to give undue importance to so common a fact, we ask any observer to notice that every acre of land has its own angle of inclination, giving in the aggregate millions of topographical lines, all diverse, and all so related as not in any way to hinder the escape of water falling in rains!

Coal is universally, but not evenly distributed throughout this area; but it should be remembered that most of this region comprises the upper coal measures, leaving the middle and lower yet to be explored by test wells and shafts. The surface coals, or those out-cropping in ravines, and often on prairie slopes, are of excellent quality, varying in thickness from one to five feet. This class of coal has been extensively mined, and many points are already noted for their extensive coal trade, viz: Fort Scott, Burlingame, Emporia, Ottawa, Lawrence, Topeka, Pleasanton, Oswego, Osage-Mission, Chetopa, Kansas City, Camden, Lexington, Centertown, Knob-Noster, &c., &c.

The most extensive deposits have been found on the Cherokee Neutral Lands; but recent discoveries assure us of abundant supplies, also, upon the Osage Lands.

These coals lie so near the surface as to admit of stripping. A majority of the farmers, by this means, have a coal patch or mine at home, from which their own wants are supplied. When the coal bed is scant, a journey of several miles is sometimes performed. And when stripping requires too much labor, the next farm or section may afford a better opening.

And these coals are excellent for all purposes—making iron either in furnaces or rolling mills—making steam, whether for factories, mills or locomotives—in gas works or for domestic use. They are singularly free from sulphur and burn with the clear white flame of Pittsburgh coals.

Their general distribution adds greatly to the value of the lands in this part of Kansas and Missouri, as all will appreciate.

A farm of 160 acres, underlaid with coal, is of more value than the same area with 80 acres of woodland. In the former case fuel is already prepared and stored for the wants of a hundred generations. In the latter, a few years would exhaust the supply.

This bituminous coal field, which is so ample in its extent, but generally affording only thin beds from ten to twenty-four inches, is occasionally enlarged, giving three feet or more in thickness; but these are merely local surprises. The fuel question—quite as important as food—is not and cannot at present be determined, but every year's search gives additional encouragement to settlers in proof that there shall be no lack of fuel for the thousands of people that will come hither as the years go on.

Unreliable reports are being circulated by persons who have selfish interests to promote—statements, for instance, that Kansas is underlaid with twenty-one veins of coal, from one to eight feet in thickness. The geological reports of Western States, which scarcely ever contain either correct or positive statements, declare that Kansas contains one-seventh of all the coal in the United States. Such persons should be arraigned and branded upon the forehead with the word “*ignoramus*,” and if they are fraudulent as well as ignorant, justice should be more severe.

The simple facts are good enough, and the truth, either spoken or written, is the most beautiful of all languages. But if it should prove true that Kansas is not underlaid with veins of workable coal, yet we do know that the area of valuable coal upon and under the surface is constantly enlarging by the accidental discoveries of settlers, and by those who are making diligent search.

Farther west, in Middle Kansas, Texas and Nebraska, the Tertiary coals are found in abundance, and still farther west, but lower in geological position, are found in inexhaustible beds, or strata of cretaceous coals of a quality equal to any service that may be required of bituminous coals.

We have already referred to the plenitude of coals, still further west, but we declare again upon the authority of a measuring rod, that the largest body of coal in the world lies between the Missouri river and the Rocky mountains. We know that it extends over 1,200 miles from the British possessions to Mexico, and that it out-crops along the entire line at the foot-hills of the eastern slope of the Rocky range. Its breadth we know to be, in some places, over 120 miles. It contains five workable veins, averaging over

six feet in thickness. The distribution of these coals to all parts of the plains, and to those States and Territories where they are needed, will be a leading business of all railroads extending across the mountains. Within eighteen months, coal has been discovered near Ellsworth, on the Kansas Pacific R. R. It is a spongy coal, but exists in great abundance, in veins from two feet to three and a half feet thick. It has been referred to the Tertiary group of rocks. It will possibly supply 250 miles of railway. Since its development and use, wood has fallen from \$50 to \$10 per cord.

Timber, as usual, accompanies all large streams in quantities sufficient for most purposes, fencing, barns, &c. Pine lumber is brought from Chicago or the railroad shipping points on the Mississippi River, and to some extent from Texas.

To those that have learned that prairie is more valuable than timber, there is no deficiency in this respect. The leading varieties are oak, poplar, hickory, black walnut, pecan, hackberry, &c. The quantity of timber, compared with prairie, decreases westward and increases towards the south until in some portions of the Indian Territory and Texas, the country is half covered with groves.

The soil of this district presents but few varieties. It is for the most part the rich, dark carbonaceous mould of the great prairie system of the West. It varies from one to seven feet in thickness and is underlaid by a stratum of hard clay, or "brick clay," when not underlaid with limestone, but so compact that cisterns may be dug or scooped in it, where there is no living water upon the highlands and divides. Occasionally, the soil is of a red ochreous color. Among sandstone ledges or base rock, there is sand and clay intermingled in the soil above. During the Drift period large tracts were overlaid with thin gravel beds, derived from the vast conglomerate deposit lying far to the north and west, and these again were doubtless derived through the agency of glaciers from the Rocky Mountain range. But of whatever variety, it is equal to any crop service that may be required of it, upon terms which every good farmer knows. The practice of selecting bottom lands for farms and rejecting uplands, or reckoning them of little value, is erroneous. Within two years the uplands have been cultivated and have proved to be as productive as river bottoms.

The best selection for a farm, however, should include both upland and bottom land, and this can generally be secured, except on the high divides.

But the especial attraction of South-eastern Kansas are her unfailing fruits. It is a well known fact that in September, 1869, at the National Fair, held at Philadelphia, the highest prize—a gold medal—was awarded to Kansas for the best display of assorted fruits, as apples, pears, peaches, grapes, &c. But it should be remembered that in the year 1869, there was a general failure of fruits in the Western States. In Kansas and Missouri, fruits large and small, never fail; and with this assurance it will soon become the fruit-grower's paradise. The region between the Kansas Pacific Railroad, and the north line of the Indian Territory, 160 miles north and south, comprising South-eastern Kansas and Western Missouri, is all within the great fruit bearing region of the United States. But it will be seen, at the same time, that the timber and broken regions of Illinois, Indiana and Missouri also extend across this line, and being for the most part inaccessible by railroads, we perceive that Kansas possesses decided advantages over those regions.

It needs no wisdom to forecast the immense fruit trade of Southern Kansas, whose beginnings have already surprised the whole country.

The temperature, salubrity and moisture of the atmosphere, in a word, the climate, might be easily inferred from the foregoing facts. Of the temperature, a good measure, in the winter, is the thickness of ice, which makes from four to ten inches. The fall of snow is light, and soon disappears. The air has that clearness which is noticeable upon the plains, and is a proof of its purity. Fresh meats exposed, will dry, but not decay.

Invalids from many States have sought their health here and found it. This mild, equable climate of the middle and lower temperate zones has alone attracted thousands of families from Northern Illinois, Wisconsin, Michigan and Minnesota, where only the most vigorous can hope to realize the limit of three score and ten years.

The precipitation of rain will average for each year 40 inches—a fact which ought to banish the fear of all who desire to dwell in this goodly land but who dread the “drouth,” or dry season. We will here state that with the year 1860, this entire region has had only two dry seasons. But this would hardly excite remark in older States like Ohio, where drouth is more severe. As a consequence, both of rich soils and mild skies, the grasses which grow luxuriantly during the summer, afford, in winter, plentiful food for flocks and herds. The entire region south of the Kansas Pacific Railroad is the herdsman’s country. That he shall become rich, is only a question of time. The prairie grasses, withered by frosts and dried in the “Indian summer,” afford substance during all the winter months; it being necessary to provide for the occasional snows. Most farmers as well as herdsman cut a few tons of hay. Little or no care, beyond watching, is bestowed upon herds, and therefore the cost is trifling. A faithful lad and his dog suffice for a drove of 500 head. Further south even these are not needed. The proprietor merely cuts or brands his mark upon each animal, of which public notice is made, and the purchaser may select his number, bearing that brand, from all herds, indiscriminately—the brand or sign being the sole and sufficient proof of his property.

This trade must assume immense proportions, increasing with the years, and receding towards the unoccupied lands. Large grazing farms, however, will take the place of ranges, herds and herdsman, with far more benefit to all branches of industry. There are already enclosed and occupied, hundreds of grazing farms, comprising from one to five sections of land.

It has been often proved, and is now generally acknowledged that domestic cattle of improved breeds are far more profitable than Texas cattle, herds of which are for the most part, indiscriminate crowds of all sizes, ages and conditions, bought chiefly for their cheapness, on account of the hazard and hardship in transferring the drove from the plains of Texas, or the Indian Territory, to a shipping point.

The profits of raising cattle are greater than offered in any other branch of agriculture. The best drovers and herders say that the

